Titration Who Done It: Vial A

Agent Hunt from Mission Impossible needs your help! An IMF agent has been sending messages to the media about their secret missions. The problem is Hunt can’t seem to catch them in the act. In his last attempt he was only moments too late in discovering them at their rendezvous site. All that was left of the meeting were some puddles on the table and some wet papyrus. After some careful deductive reasoning Hunt concluded that the informant had been using the papyrus to write messages on. Once the messages had been read they were destroyed by dissolving the papyrus in acid. A sample of the acid was obtained and is in **VIAL X.** After the discovery Hunt had all the agents in the IMF searched and three were found with bottles of the same acid at different concentrations, Agent Aimsley, Agent Bedford, and Agent Crawford. It is your mission, if you choose to accept it, to determine the concentrations of each acid in **Vials A, B** and **C** and find the match to the acid at the rendezvous site!

This Lab will be performed in groups of 4, each member will find out the concentration of one vial of acid using the stoichiometry calculations learned in class. Afterwards, you will compare answers with your group members to determine which agent was the snitch.

### Pre-Lab Questions:

1. List the Characteristics of acids and the characteristics of bases.
2. Write out the neutralization reaction for NaOH and HCl
3. It takes 20mL of a 2 mol/L solution of NaOH to neutralize 15 mL of an HCl solution of unknown concentration. Use stoichiometry to calculate the concentration of the HCl solution.

## Materials:

|  |  |  |
| --- | --- | --- |
| Table 1 – Materials for the titration of hydrochloric acid | | |
| NaOH (0.1M) | 150 ml |  |
| HCl: Vial A | 75 ml |  |
| Phenolphthalein | 3 drops | 1% solution in alcohol |
| Distilled water | 150 ml |  |
| Buret | 1 | Capacity =50 ml |
| Buret stand (base pole & clamp) | 1 |  |
| Beaker | 2 | Waste beaker: 500ml  Base Beaker: 150 ml |
| Erlenmeyer flask | 3 | Capacity : 150 ml |
| Graduated cylinder | 1 | Capacity = 50 ml |
| Funnel | 1 |  |
| Safety goggles | 1 |  |
| Gloves | 1 pair | If available |

**SAFETY: Note that both HCl and NaOH are irritants. Wear gloves and goggles throughout the lab. We are using low concentrations of both, nonetheless report all spills to your teacher immediately. Notify your teacher if the acid or base comes into contact with your skin or eyes.**

### Procedure:

**The initial titration is done quickly. The second and the third are slower and more accurate. For the second and third titration, you can quickly run the base up to a volume that is 5ml less than the total volume in the initial run (eg. to 20ml if your initial run used 25ml of NaOH). From there, slowly drip the base into the acid, swirling after each drop.**

1. Add 50 ml of distilled water into a clean Erlenmeyer flask
2. Using the graduated cylinder, measure 15ml of acid from the **Vial A** solution and add it to the Erlenmeyer flask
3. Add 3 drops of phenolphthalein
4. Rinse buret by adding distilled water and draining it into the waste beaker. (the tap is closed when horizontal and open when vertical), repeat with a small amount of your NaOH solution.
5. Fill buret with NaOH solution
6. Allow the liquid in the buret to come down to the zero mark and close tap (this will also get rid of any bubble in the tap.
7. Place the Erlenmeyer flask with the acid solution under the buret
8. Slowly drip the solution of sodium hydroxide into the acid solution, continually swirling the flask as you go.
9. As soon as the beaker solution becomes pink and *keeps the colour*, close the tap of the buret (remember to go slowly, the lighter the pink the more accurate the results)
10. Note the volume of the titrating solution you have used.
11. Refill the NaOH solution in the buret and repeat steps 6-10 for runs 2 and 3
12. Use stoichiometry to calculate the concentration of the acid in Vial A (remember the initial dilution of the solution)

### Results Table:

|  |  |  |
| --- | --- | --- |
|  | Vial A Calculations | |
| Volume NaOH | Concentration of HCl |
| Trial 1 |  |  |
| Trial 2 |  |  |
| Trial 3 |  |  |

### Group Results:

|  |  |  |  |
| --- | --- | --- | --- |
| Vial A | Vial B | Vial C | Vial X |
|  |  |  |  |

### Discussion Questions:

1. What was the purpose of the indicator in the lab?
2. Why were you able to pour your final solution down the sink?
3. What are the advantages and disadvantages of using titration to determine concentration?

Titration Who Done It: Vial B

Agent Hunt from Mission Impossible needs your help! An IMF agent has been sending messages to the media about their secret missions. The problem is Hunt can’t seem to catch them in the act. In his last attempt he was only moments too late in discovering them at their rendezvous site. All that was left of the meeting were some puddles on the table and some wet papyrus. After some careful deductive reasoning Hunt concluded that the informant had been using the papyrus to write messages on. Once the messages had been read they were destroyed by dissolving the papyrus in acid. A sample of the acid was obtained and is in **VIAL X.** After the discovery Hunt had all the agents in the IMF searched and three were found with bottles of the same acid at different concentrations, Agent Aimsley, Agent Bedford, and Agent Crawford. It is your mission, if you choose to accept it, to determine the concentrations of each acid in **Vials A, B** and **C** and find the match to the acid at the rendezvous site!

This Lab will be performed in groups of 4, each member will find out the concentration of one vial of acid using the stoichiometry calculations learned in class. Afterwards, you will compare answers with your group members to determine which agent was the snitch.

### Pre-Lab Questions:

1. List the Characteristics of acids and the characteristics of bases.
2. Write out the neutralization reaction for NaOH and HCl
3. It takes 20mL of a 2 mol/L solution of NaOH to neutralize 15 mL of an HCl solution of unknown concentration. Use stoichiometry to calculate the concentration of the HCl solution.

## Materials:

|  |  |  |
| --- | --- | --- |
| Table 1 – Materials for the titration of hydrochloric acid | | |
| NaOH (0.1M) | 150 ml |  |
| HCl: Vial B | 75 ml |  |
| Phenolphthalein | 3 drops | 1% solution in alcohol |
| Distilled water | 150 ml |  |
| Buret | 1 | Capacity =50 ml |
| Buret stand (base pole & clamp) | 1 |  |
| Beaker | 2 | Waste beaker: 500ml  Base Beaker: 150 ml |
| Erlenmeyer flask | 3 | Capacity : 150 ml |
| Graduated cylinder | 1 | Capacity = 50 ml |
| Funnel | 1 |  |
| Safety goggles | 1 |  |
| Gloves | 1 pair | If available |

**SAFETY: Note that both HCl and NaOH are irritants. Wear gloves and goggles throughout the lab. We are using low concentrations of both, nonetheless report all spills to your teacher immediately. Notify your teacher if the acid or base comes into contact with your skin or eyes.**

### Procedure:

**The initial titration is done quickly. The second and the third are slower and more accurate. For the second and third titration, you can quickly run the base up to a volume that is 5ml less than the total volume in the initial run (eg. to 20ml if your initial run used 25ml of NaOH). From there, slowly drip the base into the acid, swirling after each drop.**

1. Add 50 ml of distilled water into a clean Erlenmeyer flask
2. Using the graduated cylinder, measure 15ml of acid from the **Vial B** solution and add it to the Erlenmeyer flask
3. Add 3 drops of phenolphthalein
4. Rinse buret by adding distilled water and draining it into the waste beaker. (the tap is closed when horizontal and open when vertical), repeat with a small amount of your NaOH solution.
5. Fill buret with NaOH solution
6. Allow the liquid in the buret to come down to the zero mark and close tap (this will also get rid of any bubble in the tap.
7. Place the Erlenmeyer flask with the acid solution under the buret
8. Slowly drip the solution of sodium hydroxide into the acid solution, continually swirling the flask as you go.
9. As soon as the beaker solution becomes pink and *keeps the colour*, close the tap of the buret (remember to go slowly, the lighter the pink the more accurate the results)
10. Note the volume of the titrating solution you have used.
11. Refill the NaOH solution in the buret and repeat steps 6-10 for runs 2 and 3
12. Use stoichiometry to calculate the concentration of the acid in Vial B (remember the initial dilution of the solution)

### Results Table:

|  |  |  |
| --- | --- | --- |
|  | Vial B Calculations | |
| Volume NaOH | Concentration of HCl |
| Trial 1 |  |  |
| Trial 2 |  |  |
| Trial 3 |  |  |

### Group Results:

|  |  |  |  |
| --- | --- | --- | --- |
| Vial A | Vial B | Vial C | Vial X |
|  |  |  |  |

### Discussion Questions:

1. What was the purpose of the indicator in the lab?
2. Why were you able to pour your final solution down the sink?
3. What are the advantages and disadvantages of using titration to determine concentration?

Titration Who Done It: Vial C

Agent Hunt from Mission Impossible needs your help! An IMF agent has been sending messages to the media about their secret missions. The problem is Hunt can’t seem to catch them in the act. In his last attempt he was only moments too late in discovering them at their rendezvous site. All that was left of the meeting were some puddles on the table and some wet papyrus. After some careful deductive reasoning Hunt concluded that the informant had been using the papyrus to write messages on. Once the messages had been read they were destroyed by dissolving the papyrus in acid. A sample of the acid was obtained and is in **VIAL X.** After the discovery Hunt had all the agents in the IMF searched and three were found with bottles of the same acid at different concentrations, Agent Aimsley, Agent Bedford, and Agent Crawford. It is your mission, if you choose to accept it, to determine the concentrations of each acid in **Vials A, B** and **C** and find the match to the acid at the rendezvous site!

This Lab will be performed in groups of 4, each member will find out the concentration of one vial of acid using the stoichiometry calculations learned in class. Afterwards, you will compare answers with your group members to determine which agent was the snitch.

### Pre-Lab Questions:

1. List the Characteristics of acids and the characteristics of bases.
2. Write out the neutralization reaction for NaOH and HCl
3. It takes 20mL of a 2 mol/L solution of NaOH to neutralize 15 mL of an HCl solution of unknown concentration. Use stoichiometry to calculate the concentration of the HCl solution.

## Materials:

|  |  |  |
| --- | --- | --- |
| Table 1 – Materials for the titration of hydrochloric acid | | |
| NaOH (0.1M) | 150 ml |  |
| HCl: Vial A | 75 ml |  |
| Phenolphthalein | 3 drops | 1% solution in alcohol |
| Distilled water | 150 ml |  |
| Buret | 1 | Capacity =50 ml |
| Buret stand (base pole & clamp) | 1 |  |
| Beaker | 2 | Waste beaker: 500ml  Base Beaker: 150 ml |
| Erlenmeyer flask | 3 | Capacity : 150 ml |
| Graduated cylinder | 1 | Capacity = 50 ml |
| Funnel | 1 |  |
| Safety goggles | 1 |  |
| Gloves | 1 pair | If available |

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### Procedure:

**The initial titration is done quickly. The second and the third are slower and more accurate. For the second and third titration, you can quickly run the base up to a volume that is 5ml less than the total volume in the initial run (eg. to 20ml if your initial run used 25ml of NaOH). From there, slowly drip the base into the acid, swirling after each drop.**

1. Add 50 ml of distilled water into a clean Erlenmeyer flask
2. Using the graduated cylinder, measure 15ml of acid from the **Vial C** solution and add it to the Erlenmeyer flask
3. Add 3 drops of phenolphthalein
4. Rinse buret by adding distilled water and draining it into the waste beaker. (the tap is closed when horizontal and open when vertical), repeat with a small amount of your NaOH solution.
5. Fill buret with NaOH solution
6. Allow the liquid in the buret to come down to the zero mark and close tap (this will also get rid of any bubble in the tap.
7. Place the Erlenmeyer flask with the acid solution under the buret
8. Slowly drip the solution of sodium hydroxide into the acid solution, continually swirling the flask as you go.
9. As soon as the beaker solution becomes pink and *keeps the colour*, close the tap of the buret (remember to go slowly, the lighter the pink the more accurate the results)
10. Note the volume of the titrating solution you have used.
11. Refill the NaOH solution in the buret and repeat steps 6-10 for runs 2 and 3
12. Use stoichiometry to calculate the concentration of the acid in Vial C (remember the initial dilution of the solution)

### Results Table:

|  |  |  |
| --- | --- | --- |
|  | Vial C Calculations | |
| Volume NaOH | Concentration of HCl |
| Trial 1 |  |  |
| Trial 2 |  |  |
| Trial 3 |  |  |

### Group Results:

|  |  |  |  |
| --- | --- | --- | --- |
| Vial A | Vial B | Vial C | Vial X |
|  |  |  |  |

### Discussion Questions:

1. What was the purpose of the indicator in the lab?
2. Why were you able to pour your final solution down the sink?
3. What are the advantages and disadvantages of using titration to determine concentration?

Titration Who Done It: Vial X

Agent Hunt from Mission Impossible needs your help! An IMF agent has been sending messages to the media about their secret missions. The problem is Hunt can’t seem to catch them in the act. In his last attempt he was only moments too late in discovering them at their rendezvous site. All that was left of the meeting were some puddles on the table and some wet papyrus. After some careful deductive reasoning Hunt concluded that the informant had been using the papyrus to write messages on. Once the messages had been read they were destroyed by dissolving the papyrus in acid. A sample of the acid was obtained and is in **VIAL X.** After the discovery Hunt had all the agents in the IMF searched and three were found with bottles of the same acid at different concentrations, Agent Aimsley, Agent Bedford, and Agent Crawford. It is your mission, if you choose to accept it, to determine the concentrations of each acid in **Vials A, B** and **C** and find the match to the acid at the rendezvous site!

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2. Write out the neutralization reaction for NaOH and HCl
3. It takes 20mL of a 2 mol/L solution of NaOH to neutralize 15 mL of an HCl solution of unknown concentration. Use stoichiometry to calculate the concentration of the HCl solution.

## Materials:

|  |  |  |
| --- | --- | --- |
| Table 1 – Materials for the titration of hydrochloric acid | | |
| NaOH (0.1M) | 150 ml |  |
| HCl: Vial A | 75 ml |  |
| Phenolphthalein | 3 drops | 1% solution in alcohol |
| Distilled water | 150 ml |  |
| Buret | 1 | Capacity =50 ml |
| Buret stand (base pole & clamp) | 1 |  |
| Beaker | 2 | Waste beaker: 500ml  Base Beaker: 150 ml |
| Erlenmeyer flask | 3 | Capacity : 150 ml |
| Graduated cylinder | 1 | Capacity = 50 ml |
| Funnel | 1 |  |
| Safety goggles | 1 |  |
| Gloves | 1 pair | If available |

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### Procedure:

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1. Add 50 ml of distilled water into a clean Erlenmeyer flask
2. Using the graduated cylinder, measure 15ml of acid from the **Vial X** solution and add it to the Erlenmeyer flask
3. Add 3 drops of phenolphthalein
4. Rinse buret by adding distilled water and draining it into the waste beaker. (the tap is closed when horizontal and open when vertical), repeat with a small amount of your NaOH solution.
5. Fill buret with NaOH solution
6. Allow the liquid in the buret to come down to the zero mark and close tap (this will also get rid of any bubble in the tap.
7. Place the Erlenmeyer flask with the acid solution under the buret
8. Slowly drip the solution of sodium hydroxide into the acid solution, continually swirling the flask as you go.
9. As soon as the beaker solution becomes pink and *keeps the colour*, close the tap of the buret (remember to go slowly, the lighter the pink the more accurate the results)
10. Note the volume of the titrating solution you have used.
11. Refill the NaOH solution in the buret and repeat steps 6-10 for runs 2 and 3
12. Use stoichiometry to calculate the concentration of the acid in Vial X (remember the initial dilution of the solution)

### Results Table:

|  |  |  |
| --- | --- | --- |
|  | Vial X Calculations | |
| Volume NaOH | Concentration of HCl |
| Trial 1 |  |  |
| Trial 2 |  |  |
| Trial 3 |  |  |

### Group Results:

|  |  |  |  |
| --- | --- | --- | --- |
| Vial A | Vial B | Vial C | Vial X |
|  |  |  |  |

### Discussion Questions:

1. What was the purpose of the indicator in the lab?
2. Why were you able to pour your final solution down the sink?
3. What are the advantages and disadvantages of using titration to determine concentration?